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# Forest Insect & Disease Management
# Pacific Northwest Region

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ROOT DISEASE SURVEYS

OF THE HYATT LAKE REHAB AND HOWARD

WILLOW SALES

MEDFORD DISTRICT

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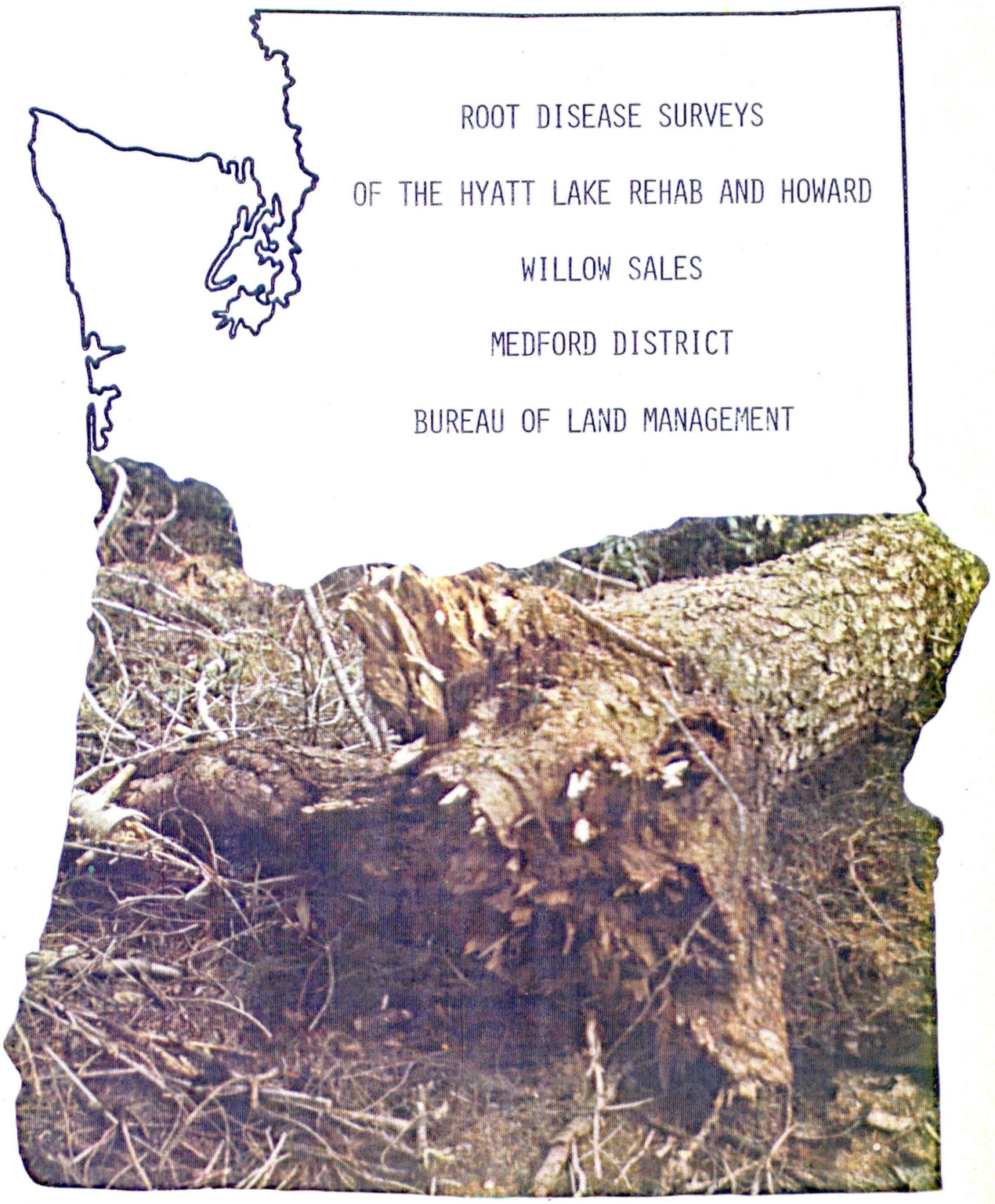

# Root Disease Surveys of the Hyatt Lake Rehab and Howard Willow Sales, Medford District Bureau of Land Management

by

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Appreciation is extended to Randy Gould of the District for assisting in the field work.

## INTRODUCTION

On October 23 and 24, 1979, root disease surveys were done on the Hyatt Lake Rehab Sale (T. 39 S., R. 3 E., secs. 21 and 28) and the Howard Willow Sale (T. 38 S., R. 3 E., sec. 25), Klamath Area, Medford District, BLM. These two sale areas exhibit substantial damage due to laminated root rot (caused by *Phellinus (Poria) weirii*), and the BLM intends to harvest and institute disease control in both. The surveys reported here were done to quantify disease severity and provide information on disease distribution.

## METHODS

Approximately 110 acres (Units II and IIIA) in the Hyatt Lake Rehab Sale area (Figures 1 and 2) and 50 acres in the Howard Willow Sale area (Figures 1 and 3) were surveyed systematically. Plots were located on a 3x2 chain grid in the first area and a 5x2 chain grid in the second. A 40 factor prism was used to define each plot. All "in" trees regardless of condition (living, dead, standing, or down) were tallied and had DBH measured. In addition, two roots on opposite sides of each standing tree were exposed to a distance of 3 feet from the root crown and examined for evidence of disease. Basal area per acre, number of trees per acre, and volume per acre were calculated by diameter class, tree species, and disease condition from prism data. Also, stumps from harvested trees were counted and infection was recorded.

## RESULTS

Hyatt Lake Rehab Sale - The stand on this unit was composed predominantly of white fir (*Abies concolor*) with lesser components of Douglas-fir (*Pseudotsuga menziesii*) and incense cedar (*Libocedrus decurrens*). The stand had been selectively harvested in the past and there were many large stumps. Per acre basal area, number of trees and volume are summarized for the sale area in Tables 1, 2, and 3.

Laminated root rot was readily identified by the distinctive decay, setal hyphae, and ectotrophic mycelium of the causal fungus. Seventy-one percent of all of the trees representing 50 percent of the volume was found to be infected by *P. weirii*, and 55 percent representing 33 percent of the board-foot volume was already dead. Based on examination of recent kills, it appeared that mortality was accelerating at the time of the survey, and volume was being lost at a rate of 425 board feet per acre per year.

A slightly larger proportion of all Douglas-fir was infected than white fir (74 vs 70 percent) and a substantially larger proportion (71 vs 53 percent) was dead. Laminated root rot was distributed throughout the survey unit. No root disease infected incense cedars were found in the survey area.

In addition to *P. weirrii, Fomes annosus* (cause of annosus root rot) was detected in a substantial number (28 percent) of old-growth white fir stumps throughout the area. This fungus was identified by the characteristic buff-white fruiting bodies it produces and typical stringy white decay.

Howard Willow Sale - The stand contained mainly white fir with some Douglas-fir and incense cedar. It, too, had been harvested selectively in the past and contained many stumps. Per acre basal area, number of trees, and volume are summarized for the stand in Tables 4, 5, and 6.

Twenty-two percent of the trees containing 23 percent of the volume was infected by *P. weirii*. Seven percent representing seven percent of the board-foot volume was dead.

A higher proportion of Douglas-fir than white fir was infected (71 vs 14 percent) and dead (32 vs 1 percent). Infection was concentrated along the southern edge of the area surveyed. No root disease infected incense cedars were found.

*Fomes annosus* was found in 50 percent of the old-growth white fir stumps throughout the stand.

## DISCUSSION

The Hyatt Lake Sale unit surveyed in this investigation exhibits the highest level of *P. weirii* infection that we have observed in any southern Oregon forest. Though not nearly so severe, the Howard Willow Sale area is nevertheless also badly diseased. Other areas in the vicinities of both units also exhibit considerable damage due to laminated root rot.

Laminated root rot is a particularly dangerous disease because the causal agent is persistent on the site. It can survive for long time periods (up to 50 years) in roots of large old stumps, infecting via root contacts new hosts that become established on the site. Infection centers and resulting mortality develop as the fungus subsequently spreads from tree to tree along roots.

Recommended control for laminated root rot is to cut all susceptible hosts in infection centers and a 50-foot buffer around each and (1) mechanically remove all inoculum (infected roots and stumps), or (2) leave inoculum but replant with immune, resistant, or tolerant tree species. In the survey areas, immune species would be hardwoods; resistant species would be incense cedar and ponderosa pine; and tolerant species would be sugar pine and lodgepole pine. Data from this and other surveys indicate that, while both Douglas-fir and white fir are highly susceptible to *P. weirii*, Douglas-fir is more badly damaged than is white fir.

The BLM intends to employ both stump removal and species manipulation control techniques on the Hyatt Lake Sale area. The area will serve as a control demonstration area in the future. Similar control prescriptions should be considered for the Howard Willow Sale area and for other severely diseased units on the District.

The occurrence of *Fomes annosus* at apparently high levels in white fir stumps in the surveyed areas is interesting and reason for concern. The fungus is also being found at fairly high levels in true fir in northern California and some East Side Oregon localities. The fungus colonizes freshly cut stumps, grows through the roots and hence across root grafts, and contacts into the roots of surrounding healthy trees. It also infects through wounds. In true firs, it usually does not kill trees outright, but causes a butt rot. It may cause substantial tree weakening in advanced stages and apparently predisposes trees to attack by other pests, particularly fir engraver beetles. The effects of annosus root rot in the survey area are unknown, but it may be contributing to some white fir decline in combination with *Phellinus weirii*. Stump removal would certainly control *F. annosus* as well as *P. weirii*. *Fomes annosus* has a wide host range that includes most conifers, so the fungus would still have some potential to cause damage if stumps were left and tree species were changed. This would probably be minimal, however. California studies indicate that the true fir isolate of *F. annosus* infects pines and incense cedar only on rare occasions.

Forest Pest Management pathologists are available to assist the BLM in implementing any of the disease management alternatives or to expand upon information in this report.

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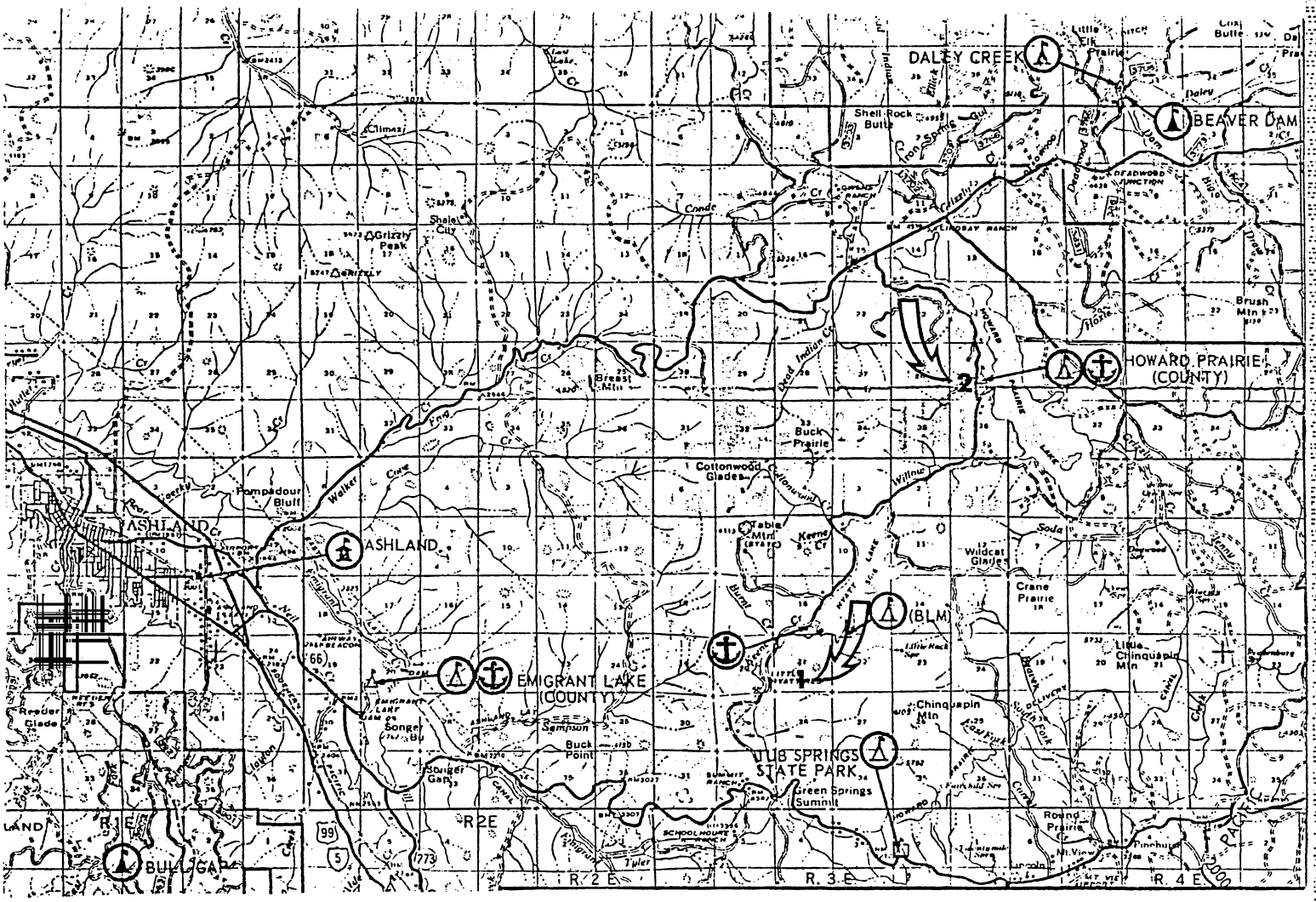


Figure 1. Location of areas surveyed (arrows):
1 = Hyatt Lake Sale, 2 = Howard Willow Sale

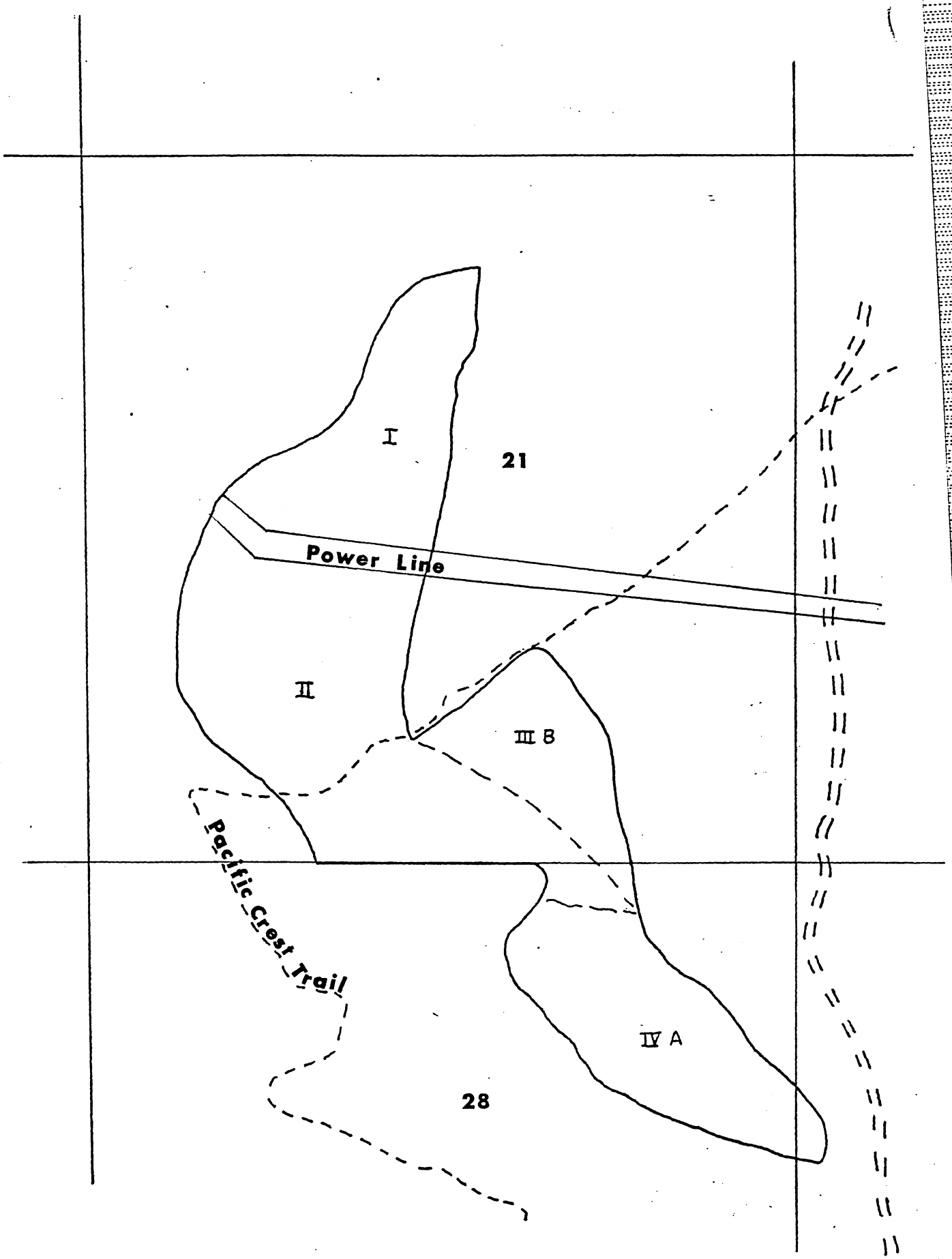


Figure 2. Hyatt Lake Sale area: Units II and IIIB were surveyed in this evaluation

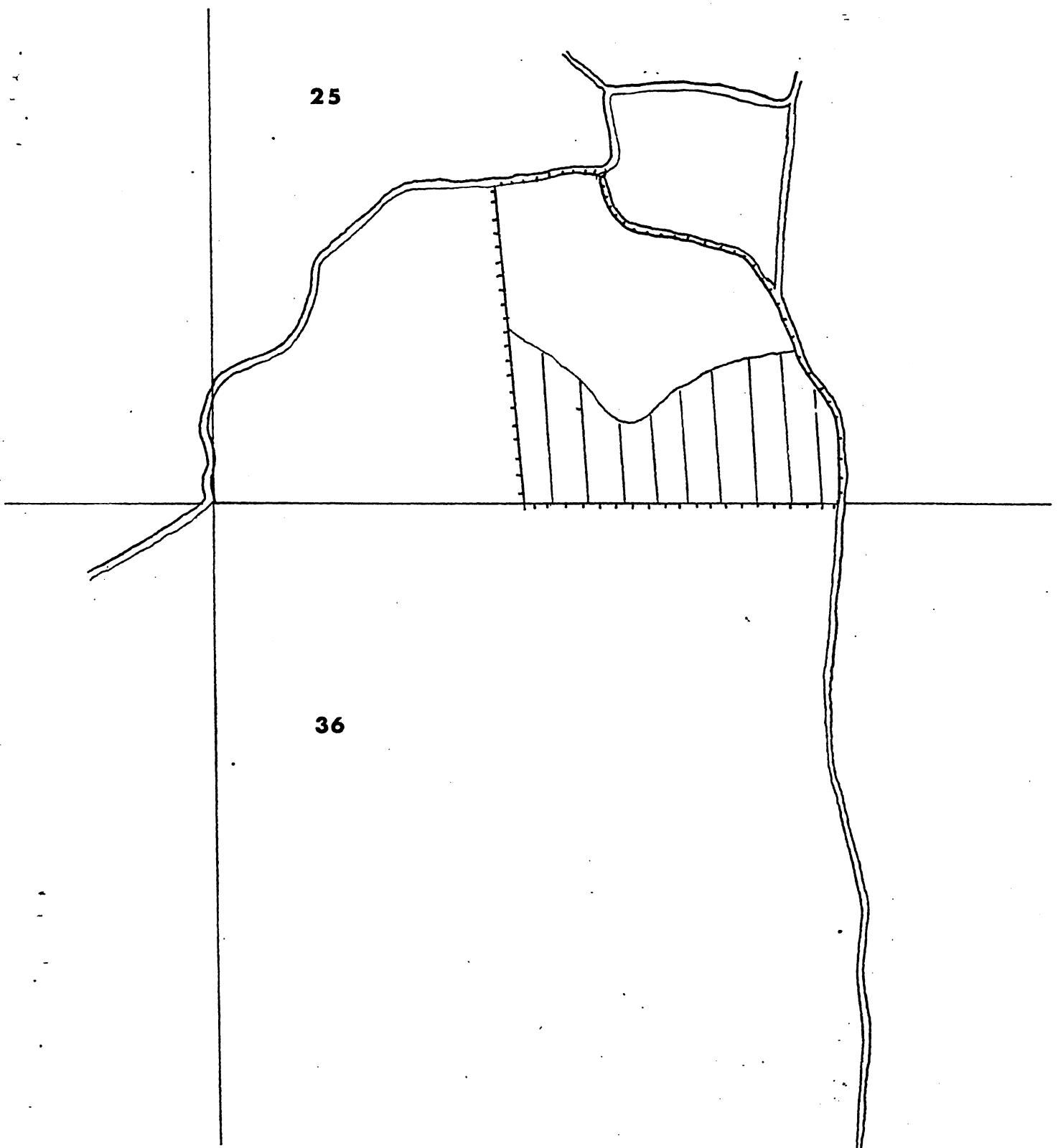


Figure 3. Portion of Howard Willow Sale: the unit within the fringed area was surveyed and the cross-hatched area had substantial laminated root rot.

Figure 1. Basal Area Per Acre ($Ft.^2$) for Hyatt lake Rehab Sale Area

| DBH Class | White Fir | | | Douglas-fir | | | Incense Cedar | | | All Species | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Healthy | Dead Diseased | Alive Diseased | Healthy | Dead Diseased | Alive Diseased | Healthy | Dead | Alive Diseased | Healthy | Dead Diseased | Alive Diseased |
| 8 | 0.0 | 2.8 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.8 | 0.8 |
| 10 | 0.0 | 7.2 | 0.8 | 0.0 | 1.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 8.8 | 0.8 |
| 12 | 0.0 | 8.8 | 1.6 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 9.6 | 1.6 |
| 14 | 6.4 | 5.2 | 1.6 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 6.4 | 6.0 | 1.6 |
| 16 | 4.4 | 4.4 | 4.4 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 4.4 | 5.2 | 4.4 |
| 18 | 6.0 | 4.4 | 0.0 | 1.2 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 7.2 | 5.2 | 0.0 |
| 20 | 6.0 | 2.8 | 4.4 | 0.4 | 1.6 | 0.0 | 0.0 | 0.0 | 0.0 | 6.4 | 4.4 | 4.4 |
| 22 | 16.0 | 1.6 | 0.8 | 1.2 | 1.6 | 0.0 | 0.0 | 0.0 | 0.0 | 17.2 | 3.2 | 0.8 |
| 24 | 9.6 | 0.8 | 6.8 | 0.8 | 2.0 | 0.0 | 0.8 | 0.0 | 0.0 | 11.2 | 2.8 | 6.8 |
| 26 | 0.8 | 3.6 | 0.8 | 0.4 | 0.8 | 0.8 | 0.0 | 0.0 | 0.0 | 1.2 | 4.4 | 1.6 |
| 28 | 0.0 | 0.0 | 1.6 | 1.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.6 | 0.0 | 1.6 |
| 30 | 6.0 | 0.0 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.0 | 2.0 | 0.0 |
| 32 | 0.8 | 0.8 | 0.8 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.6 | 0.8 | 0.8 |
| 34 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 1.6 | 0.0 |
| 36 | 0.0 | 0.0 | 0.0 | 4.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.4 | 0.0 | 0.0 |
| 38 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.8 | 0.0 | 0.8 | 0.0 | 0.8 | 1.6 | 0.0 |
| 40 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 42 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 |
| 44 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 46 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 48 | 0.0 | 0.8 | 0.0 | 0.0 | 0.8 | 0.0 | 0.8 | 0.0 | 0.0 | 0.8 | 1.6 | 0.0 |
| 50 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 |
| 52+ | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total | 56.0 | 43.2 | 24.4 | 11.6 | 15.2 | 1.6 | 2.4 | 1.6 | 0.0 | 70.0 | 60.8 | 25.2 |

Figure 2. Mean Number of Trees Per Acre for Hyatt Lake Rehab Sale Area

| DBH Class | White Fir | | | Douglas-fir | | | Incense Cedar | | | All Species | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Healthy | Dead Diseased | Live Diseased | Healthy | Dead Diseased | Live Diseased | Healthy | Dead | Alive Diseased | Healthy | Dead Diseased | Alive Diseased |
| 8 | 0.0 | 8.0 | 2.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 8.0 | 2.3 |
| 10 | 0.0 | 13.2 | 1.5 | 0.0 | 2.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16.1 | 1.5 |
| 12 | 0.0 | 11.2 | 2.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 12.2 | 2.0 |
| 14 | 5.9 | 4.9 | 1.5 | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 5.9 | 5.6 | 1.5 |
| 16 | 3.1 | 3.1 | 3.2 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 3.1 | 3.7 | 3.2 |
| 18 | 3.4 | 2.5 | 0.0 | 0.7 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 4.1 | 2.9 | 0.0 |
| 20 | 2.7 | 1.3 | 2.0 | 0.2 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 2.9 | 2.0 | 2.0 |
| 22 | 6.1 | 0.6 | 0.3 | 0.5 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 6.6 | 1.2 | 0.3 |
| 24 | 3.1 | 0.2 | 2.2 | 0.3 | 0.6 | 0.0 | 0.2 | 0.0 | 0.0 | 3.6 | 0.8 | 2.2 |
| 26 | 0.2 | 1.0 | 0.2 | 0.1 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.3 | 1.2 | 0.4 |
| 28 | 0.0 | 0.0 | 0.4 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.4 |
| 30 | 1.2 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 1.2 | 0.4 | 0.0 |
| 32 | 0.2 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.1 | 0.1 |
| 34 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.1 | 0.2 | 0.0 |
| 36 | 0.0 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 |
| 38 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.1 | 0.0 | 0.1 | 0.0 | 0.1 | 0.1 | 0.1 |
| 40 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 42 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 |
| 44 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 46 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 48 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | 0.2 | 0.0 |
| 50 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 |
| 52+ | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total | 25.9 | 46.2 | 15.7 | 3.1 | 8.4 | 0.3 | 0.4 | 0.2 | 0.0 | 29.4 | 54.8 | 16.0 |

Figure 3. Mean Volume Per Acre (M bd. ft.) for Hyatt Lake Rehab Sale Area

| DBH Class | White Fir | | | Douglas-fir | | | Incense Cedar | | | All Species | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Healthy | Dead Diseased | Live Diseased | Healthy | Dead Diseased | Live Diseased | Healthy | Dead | Live Diseased | Healthy | Dead Diseased | Live Diseased |
| 8 | 0.0 | 0.3 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.1 |
| 10 | 0.0 | 0.8 | 0.1 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.1 |
| 12 | 0.0 | 0.9 | 0.2 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.2 |
| 14 | 1.1 | 0.8 | 0.2 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.9 | 0.2 |
| 16 | 0.7 | 0.7 | 0.8 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.8 | 0.8 |
| 18 | 1.3 | 0.9 | 0.0 | 0.3 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 1.6 | 1.0 | 0.0 |
| 20 | 1.3 | 0.6 | 1.0 | 0.1 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 1.4 | 0.9 | 1.0 |
| 22 | 3.3 | 0.3 | 0.2 | 0.3 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 3.6 | 0.6 | 0.2 |
| 24 | 2.3 | 0.1 | 1.6 | 0.2 | 0.4 | 0.0 | 0.1 | 0.0 | 0.0 | 2.6 | 0.5 | 1.6 |
| 26 | 0.1 | 0.8 | 0.2 | 0.0 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.1 | 1.0 | 0.4 |
| 28 | 0.0 | 0.0 | 0.4 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.4 |
| 30 | 1.5 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 1.5 | 0.5 | 0.0 |
| 32 | 0.4 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.1 | 0.1 |
| 34 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.3 | 0.0 |
| 36 | 0.0 | 0.0 | 0.0 | 1.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.2 | 0.0 | 0.0 |
| 38 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.2 | 0.0 | 0.2 | 0.0 | 0.2 | 0.2 | 0.2 |
| 40 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 42 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 |
| 44 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 46 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 48 | 0.0 | 0.4 | 0.0 | 0.0 | 0.4 | 0.0 | 0.3 | 0.0 | 0.0 | 0.3 | 0.8 | 0.0 |
| 50 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 |
| 52+ | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total | 12.0 | 6.7 | 4.9 | 2.8 | 3.2 | 0.4 | 0.8 | 0.3 | 0.0 | 15.6 | 10.2 | 5.3 |

Figure 4. Basal Area Per Acre (Ft.$^2$) for Howard Willow Sale Area

| DBH Class | White Fir | | | Douglas-fir | | | Incense Cedar | | | All Species | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Healthy | Dead Diseased | Live Diseased | Healthy | Dead Diseased | Live Diseased | Healthy | Dead Diseased | Live Diseased | Healthy | Dead Diseased | Live Diseased |
| 8 | 3.6 | 0.0 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.6 | 2.0 | 0.0 |
| 10 | 30.4 | 2.0 | 0.0 | 3.6 | 0.0 | 2.0 | 2.0 | 0.0 | 0.0 | 36.0 | 2.0 | 0.0 |
| 12 | 2.0 | 2.0 | 0.0 | 0.0 | 2.0 | 2.0 | 0.0 | 0.0 | 0.0 | 2.0 | 4.0 | 0.0 |
| 14 | 3.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.6 | 0.0 | 0.0 |
| 16 | 7.6 | 5.6 | 0.0 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 | 7.6 | 5.6 | 2.0 |
| 18 | 3.6 | 2.0 | 0.0 | 0.0 | 2.0 | 2.0 | 0.0 | 0.0 | 0.0 | 3.6 | 4.0 | 2.0 |
| 20 | 24.8 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 28.8 | 0.0 | 0.0 |
| 22 | 3.6 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.6 | 2.0 | 0.0 |
| 24 | 2.0 | 0.0 | 2.0 | 0.0 | 0.0 | 3.6 | 0.0 | 0.0 | 0.0 | 2.0 | 0.0 | 5.6 |
| 26 | 17.2 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17.2 | 0.0 | 2.0 |
| 28 | 15.2 | 0.0 | 0.0 | 0.0 | 0.0 | 3.6 | 0.0 | 0.0 | 0.0 | 15.2 | 0.0 | 3.6 |
| 30 | 17.2 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17.2 | 2.0 | 0.0 |
| 32 | 2.0 | 0.0 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 | 2.0 | 0.0 |
| 34 | 15.2 | 0.0 | 0.0 | 3.6 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 18.8 | 2.0 | 0.0 |
| 36 | 2.0 | 2.0 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 | 4.0 | 0.0 |
| 38 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 40 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 42 | 0.0 | 0.0 | 0.0 | 3.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.6 | 0.0 | 0.0 |
| 44 | 0.0 | 0.0 | 0.0 | 3.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.6 | 0.0 | 0.0 |
| 46 | 0.0 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 |
| 48 | 0.0 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 |
| 50 | 0.0 | 0.0 | 0.0 | 2.0 | 3.6 | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 | 3.6 | 0.0 |
| 52+ | 0.0 | 0.0 | 0.0 | 2.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 | 2.0 | 0.0 |
| Total | 150.0 | 17.6 | 4.0 | 24.4 | 17.6 | 15.2 | 4.0 | 0.0 | 0.0 | 178.4 | 35.2 | 15.2 |

Figure 5. Mean Number of Trees Per Acre for Howard Willow Sale Area

| DBH Class | White Fir | | | Douglas-fir | | | Incense Cedar | | | All Species | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Healthy | Dead Diseased | Live Diseased | Healthy | Dead Diseased | Live Diseased | Healthy | Dead Diseased | Live Diseased | Healthy | Dead Diseased | Live Diseased |
| 8 | 10.3 | 0.0 | 0.0 | 0.0 | 5.7 | 0.0 | 0.0 | 0.0 | 0.0 | 10.3 | 5.7 | 0.0 |
| 10 | 55.7 | 3.7 | 0.0 | 6.6 | 0.0 | 3.7 | 3.7 | 0.0 | 0.0 | 66.0 | 3.7 | 3.7 |
| 12 | 2.5 | 2.5 | 0.0 | 0.0 | 2.5 | 2.5 | 0.0 | 0.0 | 0.0 | 2.5 | 5.0 | 2.5 |
| 14 | 3.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.4 | 0.0 | 0.0 |
| 16 | 5.4 | 4.0 | 0.0 | 0.0 | 0.0 | 1.4 | 0.0 | 0.0 | 0.0 | 5.4 | 4.0 | 1.4 |
| 18 | 2.0 | 1.1 | 0.0 | 0.0 | 1.1 | 1.1 | 0.0 | 0.0 | 0.0 | 2.0 | 2.2 | 1.1 |
| 20 | 11.4 | 0.0 | 0.0 | 0.9 | 0.0 | 0.0 | 0.9 | 0.0 | 0.0 | 13.2 | 0.0 | 0.0 |
| 22 | 1.4 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.4 | 0.8 | 0.0 |
| 24 | 0.6 | 0.0 | 0.6 | 0.0 | 0.0 | 1.1 | 0.0 | 0.0 | 0.0 | 0.6 | 0.0 | 1.7 |
| 26 | 4.7 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.7 | 0.0 | 0.5 |
| 28 | 3.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 3.6 | 0.0 | 0.8 |
| 30 | 3.5 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.5 | 0.4 | 0.0 |
| 32 | 0.4 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.4 | 0.0 |
| 34 | 2.4 | 0.0 | 0.0 | 0.6 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 0.3 | 0.0 |
| 36 | 0.3 | 0.3 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.6 | 0.0 |
| 38 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 40 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 42 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 |
| 44 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 |
| 46 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 |
| 48 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 |
| 50 | 0.0 | 0.0 | 0.0 | 0.1 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.3 | 0.0 |
| 52+ | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 |
| Total | 107.6 | 12.8 | 1.1 | 9.4 | 12.7 | 10.6 | 4.6 | 0.0 | 0.0 | 12.6 | 23.5 | 11.7 |

Figure 6. Mean Volume Per Acre (M bd. ft.) for Howard Willow Sale Area

| DBH Class | White Fir | | | Douglas-fir | | | Incense Cedar | | | All Species | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Healthy | Dead Diseased | Live Diseased | Healthy | Dead Diseased | Live Diseased | Healthy | Dead Diseased | Live Diseased | Healthy | Dead Diseased | Live Diseased |
| 8 | 0.4 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.2 | 0.0 |
| 10 | 3.4 | 0.2 | 0.0 | 0.4 | 0.0 | 0.2 | 0.2 | 0.0 | 0.0 | 4.0 | 0.2 | 0.2 |
| 12 | 0.2 | 0.2 | 0.0 | 0.0 | 0.3 | 0.3 | 0.0 | 0.0 | 0.0 | 0.2 | 0.5 | 0.3 |
| 14 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 |
| 16 | 1.3 | 1.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 1.3 | 1.0 | 0.4 |
| 18 | 0.7 | 0.4 | 0.0 | 0.0 | 0.4 | 0.4 | 0.0 | 0.0 | 0.0 | 0.7 | 0.8 | 0.4 |
| 20 | 5.5 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 6.2 | 0.0 | 0.0 |
| 22 | 0.8 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.6 | 0.0 |
| 24 | 0.4 | 0.0 | 0.4 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 1.1 |
| 26 | 3.7 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.7 | 0.0 | 0.4 |
| 28 | 4.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 4.0 | 0.0 | 0.8 |
| 30 | 4.4 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.4 | 0.5 | 0.0 |
| 32 | 0.6 | 0.0 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 0.6 | 0.0 |
| 34 | 4.5 | 0.0 | 0.0 | 1.1 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 5.6 | 0.5 | 0.0 |
| 36 | 0.6 | 0.6 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 1.2 | 0.0 |
| 38 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 40 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 42 | 0.0 | 0.0 | 0.0 | 1.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.3 | 0.0 | 0.0 |
| 44 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 0.0 |
| 46 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 |
| 48 | 0.0 | 0.0 | 0.0 | 0.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.9 | 0.0 | 0.0 |
| 50 | 0.0 | 0.0 | 0.0 | 0.5 | 1.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 1.4 | 0.0 |
| 52+ | 0.0 | 0.0 | 0.0 | 1.1 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.7 | 0.0 |
| Total | 31.1 | 3.5 | 0.8 | 7.6 | 4.7 | 2.8 | 0.5 | 0.0 | 0.0 | 39.2 | 8.2 | 3.6 |